ENVIRONMENTAL STUDY OF SPRING WATER QUALITY IN THE ZARQA NATURAL RESERVE – WEST RAMALLAH/ PALESTINE

Article · December 2014

CITATIONS
0

READS
64

2 authors, including:

Marwan Ghanem
Birzeit University
39 PUBLICATIONS **117** CITATIONS

SEE PROFILE

ENVIRONMENTAL STUDY OF SPRING WATER QUALITY IN THE ZARQA NATURAL RESERVE - WEST RAMALLAH/ PALESTINE

Khalil Abu Alan[1] and Marwan Ghanem*[1]
[1] Birzeit university, P.O.Box 14, Ramallah- Palestine, mghanem@birzeit.edu

ABSTRACT

This study highlights the environmental situation of the Al-Zarqa reserve's water quality, which is located in west of Beitillu village, Ramallah area. This is achieved through chemical and physical experiments on the area's water springs, and through defining the percentages of the components/elements. The goal of the study is to examine whether the water can be used by humans or not. The study also examines the water quality and its annual flow. Among the most important findings of the study, the presence of high salinity in both Abu Issam and Al_Bawlale springs and this is due to the high proportion of dissolved solids in them and high electrical conductivity while the other springs with medium salinity. For the water quality of the springs, it is (Ca_HCO3-) and due to the spread of limestone in the region, the highest positive element in the springs water is calcium, where as the negative element is bicarbonate because of the nature of calcareous rocks of the region. It also contains magnesium due to the presence of dolomite rock in the region. The study also showed high percentage of iron in Kikaba spring which is above universally acceptable level. In general, most spring's water in the area is appropriate for human use except Abu Issam, Al bawale, and Kikaba springs because of their contamination, It's due to the high of Fe in this springs. The study shows that the most significant sources of pollution in the region is due to the presence of cesspit near the water of the spring specially Abu Issam and Al-bawale springs. In addition to the proportion of nitrates was decreased in the sample springs.

Key words: Spring, Natuv, hydrochemistry

INTRODUCTION

Al-Zarqa reserve, which is located within the territory of Beitillu in the northwest of Ramallah city is considered as one of the basic and important natural reserves in Palestine. This is due to its large biodiversity, and what distinguishes Al-Zarqa reserve from any other nature reserves in Palestine is the presence of more than forty springs within its territory in a small geographic area. This study examines the chemical, physical, and biological properties of Al- Zarqa reserves springs, and the level of the heavy metals in these springs. The high proportion of chemical, and physical elements in the springs, and their increase out of the required limit makes the springs unfit for human use. Where there are many external factors that have led to high rates of elements in the water. One of the pollution factors in the reserve is random landfills like the main landfill of Beitillu village which existed near water sources. The second factor is the agricultural and house waste inside the reserve. The third factor is septic tanks which aren't designed to prevent the leakage of wastewater to groundwater. The forth factor is spraying pesticides without commitment to globally permitted standards, leading to the leakage of toxic chemical elements to the water. Therefore, the study aims to come up with the results that showing the characteristics and the quality of spring water in the reserve, and the impact of pollution sources on the spring water.

This study follows the descriptive and analytical methodology, keeping up with the beginning of the problem and the factors that led to the pollution of some water springs. Throughout the study, the analysis of the aerial photographs using the Geographical Information System (GIS) and studying the change in land use of the reserve. This study aims at Knowing the quality of the spring water in Al-Zarqa reserve and determine its suitability for agricultural and human use. The study Clarifies the impact

of landfills, agricultural pesticides, and septic tanks on the quality of spring water and how important to reduce the accumulation of solid waste, and the importance of having a septic tank to prevent the leakage of waste water into the ground water. This is to Come up with a results that illustrate the impact of the deterioration of reserves, the extent of the contamination of water sources, predict the effects and future results that resulting from the contamination of spring water, and make recommendations to ensure the preservation of reserves and reduce the pollution of the springs.

METHODOLOGY

Fieldwork was carried out to sample water springs in wet and dry periods in the years of 2012 and 2013. It was relying on the results of laboratory analysis for the water. This was after making the (hydrochemical analysis) by examining the proportion of each of pH, O_2, Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, HCO_3^-, NO_3^{2-}, SO_4^{2-} and others in the water. The physical analysis of the spring water samples, hydrological data, and hydrogeological data will help to understand the characteristics of the spring water in the study area. The descriptive and historical method was used, which helps in the study of the evolution of the problem since past and following it to provide an understanding and a more complete explanation for the evolution. As well as gaining historical information about the aimed area which make it easier to get historical information. The descriptive approach has been used to describe the problem from all sides and displaying it in an appropriate manner. Samples were collected in two phases (wet and dry seasons) from the study area. Analysis has been conducted at the laboratory of the Department of Chemistry at Birzeit University, where the samples were analyzed chemically and physically, and determine the ratios of chemical elements for the samples before and after rainfall in terms of the ratio of calcium Ca^+, Na^+, Mg^+, and potassium K^+, nitrate $NO3^-$, bicarbonate HCO3, and sulfates $SO4^-$, and

chlorine Cl. It was examined physically in terms of the amount of dissolved solids (TDS), and the electrical conductivity of the water (EC), and pH. Spring water samples from Al-Zarqa reserve was taken in the month of February 2012 for the heavy metals analysis in the spring water, including the proportions of each Al, and As, and B, Cd, Co, Cr, Cu, Fe, Hg, Mn , Ni, Pb, and Zn. The heavy metals analysis was analyzed in the laboratory of Purdue University at United States.

THE STUDY AREA

Al- Zarqa reserve is located at the west of the Beitillu village, about 19 km northwest of the city of Ramallah Most of the reserve lands owned by the residents of the Beitillu village, while the bottom of the southern part of the village is owned by the residents of Deir Ammar and Jmmala villages. A chain of mountains sited on the western and eastern side of the reserve, which make it a conduit for water in winter. The Region is characterized by the Mediterranean climate, where the climate is mild and warm at summers, and cold and rainy in winter as a result of its location in the center of the West Bank (the Central Highlands) and near the Mediterranean Sea, and confronting the winds coming from the sea during the seasons of the year. The rocks of Al-zarqa reserve are characterized by lime stones because of the significant spread of the limestone outcropping in the region. The rock permeability was the cause of the existence of a large number of springs, and dolomite rocks in the area of Zarqa. Since the region is part of the limestone rock layer that has spread widely in the West Bank. The bend of the rock layer contributed to the flow of the water to the valleys and then infiltrated into the ground. Al-Zarqa valley feeds with water from the western mountains of Birzeit town and Atara village, Beitillu Mountains that located east of Al-Zarqa reserve, and from the mountains of Deir Netham village which located in the north of the reserve.

The most important springs at Al-zarqa reserve are: al-Khanq spring, Tweiseh spring, Musa spring, Abu-Aaqlh spring, Al-Iraqia spring, Abu- Essam spring, Alba-Walee spring, Al-Ashqar spring (yellow), Alakalah spring, Radwan spring, Kekabah spring, Salem spring, Hanahen spring, Muslim spring, Al-Jarab spring, Abu-Saada spring, al-Delbah spring, Al-Jenen spring, Al-Qasab spring, and Al-Bassah spring (Map1). The overall rate of spring flow in the study area is 1482.4 m ^{3} / year. Al-Jarab spring has a biggest flow of all springs that reached 3971 m ^{3} / year, followed by Al-Delbeh spring with the rate of 3533 m ^{3} / year, and finally Al-Khanq spring with a rate of 164 m ^{3} / year.

RESULTS AND DISCUSSIONS

Physical characteristics:

The average of PH for all samples before rainfall was 7.8, since the PH was too close at Al-Bassa, Al-Qasab, Al-Jenan, and Radwan springs, and the biggest rate of PH was at Muslim spring before rainfall. While after raining, the percentage of the average raised to 8.1, and the lowest value was represented in Abu Issam spring which reached 7.8, while the highest PH value was represented in Muslim spring which reached 8.1. Through the physical tests on water, the results shows that the temperature of Al-Zarqa reserves springs ranged between 16˚ – 20˚. The lowest rate of the temperature was for Musa spring which was 15.9˚, while the highest rate was at Muslim spring which was 20˚. The temperature average for all studied springs has reached 18˚ (Sulieman, 2010). The EC average was too close during the two periods of the spring water analysis. The EC reached 681 µS / cm before raining, and 693 µS / cm after raining. Abu Issam spring contained the highest percentage of electrical conductivity through two periods at a rate of 883 µS / cm, and the lowest rate is Radwan spring 610 µS / cm. In the case of the continued increase in the proportion of salt in Abuasam spring, it exceeds the allowable limit 1000 µS / cm. The rate of TDS in the studied springs was 345.2 mg / L (Shalash, 2006).

Chemical properties of water

Cations and anions

The sodium concentration is low in the springs of Al-Zarqa reserve. The highest percentage of sodium is in Abu Issam spring 22.7 mg / L, and Al-bawalee spring 21.3 mg / l. The rate of sodium in the water depends on the proportion of dissolved salts. The highest percentages of dissolved salts in the springs are the same in Abuasam spring and Albawalee 476 and 517 mg / L, respectively. Potassium is also rates very low in the water, and the maximum rate of potassium allowed in the groundwater is 10 mg / l. The proportion of potassium is much lower than the proportion of sodium in the water. It was found that the rate of sodium in the studied springs was 16.4 mg / L, compared with the rate of potassium in the samples which was 0.79 mg / l. The highest rate was in Al-Bassa spring of 3.47 mg / l.

The percentage of calcium in the spring didn't exceed the percentage limit of 100 mg /L (WHO, 2007). The highest percentage of calcium was in Albawalee and Abuasam springs of 90 and 85 mg / L, respectively, before raining. The proportion of calcium in the rest of the springs is about 68.6 mg / l. This reflects the nature of the limestone reservoir of the underground water which flows from the springs. The proportion of magnesium did not exceed the allowable limit, and the rate of magnesium before rainfall for all samples, is 29 mg / l, and after rainfall is 30.04 mg/l (Figure 1). The rate was too close during periods of analysis and did not show a significant rise in the proportion of magnesium in the springs. The highest rate was at Albawalee spring and Abu Issam which reached 24 mg / l approximately. In the case of an increase of magnesium above 100 mg in the groundwater, that will affect human health. The presence of magnesium in the springs indicate to the presence of dolomite rock in the area, including the existing underground water reservoir (Abu Hillou, 2006) .

The rate of bicarbonate in the studied springs after the rainfall was 259.6 mg / liter, but after the rainfall the average was 177 mg / l. The decrease in the proportion of bicarbonate in the spring water after a rainfall is due to the possibility of rising water levels in the aquifer and thus lowers the proportion of bicarbonate. The results show that the rate of bicarbonate fall within the allowable limit, which is less than 400 mg/ l (WHO, 2007). This indicates the carbon nature of the springs. It has been observed that the rates in all the springs are close except the Abuasam and Albawalee springs in which there was the highest proportion of the sulfate 23 mg / l. while Abuaaqlh, Moses, and Taiwish springs contain the less amount of sulfate 11 mg / L. The proportion of sulfates rose significantly after the rainfall in all the springs. This is due to the concentration of plantings around the springs, and the use of agricultural pesticides near springs.

The highest percentage of nitrate was in Al qasab spring 12.1 mg / L, Bassa spring 10.3,and Abu Seada spring 10.2, but the rate rose significantly after the rainfall in each of Albawalee and Alkikaba spring to 9.1 and 8 mg /l (Figure 1). The reasons behind a high percentage of nitrate in the water after the rainfall is the decomposition of nitrate in the soil by running water over it, and a simple leakage from cesspits. The overall rate for NO_3^- is 5.6 mg / l. The rate of chlorine has reached the highest percentage in Albawalee, and Abuasam springs which reached 49 mg/L. The wastewater and water resulting from domestic and agricultural use are sources of chlorine (Samhan, 2007).

Heavy metals

It was found that the springs of AL-zarqa reserve contain ratios of heavy metals less than what is allowed globally of heavy metals in water. The maximum allowable percentage of iron in the water is 300 ug/L (0.3mg/L), and manganese was found in

small amounts at rate of 4.3ug/L in the springs of the study. Where there is manganese in groundwater by much less iron. Deep groundwater in manganese concentration of 200-300 mg/L, while the groundwater near concentration of 50 microgram/L. The percentage of iron has reached in spring abu Issam to 299 microgram/L, in the alkikaba spring 325 microgram/L. (Figure 2) and these amounts are higher than the allowable limits of the WHO standards.

Level of salinity in the water springs

This Depends on the electrical conductivity of the water (EC) and the salts dissolved solids (TDS) in determining the quality of the water in terms of salinity degree where this lifted the increase of impurities and salt dissolved in water of the percentage of EC. Also, the quality land uses around the springs and sources of water quality in terms of the high salinity and pollution. It is noticed from the result of test that springs ALbawaleea and Abu Issam were of high salinity because the high proportion of dissolved solid and increase the proportion of electrical conductivity while the rest springs are without contamination (Table I).

Sources of pollution in the region

Solid waste

There is near the springs of the study landfill Waet, which represent the main landfill of the villages (Bitllou, Deer Ammar amd Jamalah) wich is located in north-east on top of the adjacent mountain. That distorted the aesthetic appearance of the area, and the probability of it leaking chemical into the ground to reach the groundwater contamination in the springs water and in the case accumulation waste and the increase of size of the dumping site, the possibility leakage of hazardous chemicals gets increased springs water. 50% from the springs study susceptible to contamination in future by the dumping site.

Cesspits

Zarqa reserve is surrounded by number of major centers which are Jamalah, Beittilu, Deer ammar and Deer Nezam villages and all of them have no sewage system, depending on the cesspits for the sewage system. There are also two non-solid cesspits near the water springs. One of which is near Abu Essam springs and ALbawaleea, while the second hole is a little bit far from springs. The Laboratory analysis showed the two high rates of chemical elements comparing them with other springs in the area. As for the level of salinity for Abu Essam springs and ALbawaleea, it has been showed that presence of high percentage of salinity, It is also illustrated by the decline of Earth direction west inside the reserve from the possibility of leaking their waste water towards the stream valley and then water pollution for ongoing water may occur in the region the site stream valley can be observed within the study area (Map 1).

Pesticides and fertilizer

Farmers use in AL-Zarqa Reserve types of pesticides according to the types that affects their crops, and some if these pesticides are: GESCEN this is sprayed on the leaves plants affected by the disease of powdery mildew, and it contains 30 of the suffuse, KUNG FU CS is and insecticide for vegetables and trees, it is usually used when Balsas injury to plants or worms or when attacking while fly agricultural plants and TIMOR EC is sprayed on tree to exterminate the insects, and the Manure. However, the increase of using it leads to environmental problems in the region. Moreover, some of the manure contain organic fertilizers nitrates and thus may into groundwater when washing the soil with rain water.

CONCLUSION

The study shows high salinity water in the springs of Abu_Issam, ALbawalee and is classified as a high salinity, the other springs are without contamination, and depending on the ratios of electrical conductivity and TDS. It is showed that the rise in the proportion of calcium in spring water especially after rainfall and was not exceeding the allowable limit of the WHO. High nitrates in Bassa spring and reeds spring due to its presence in the south_Eastern part of the region and the heavily irrigated agriculture. The highest proportion of potassium found in the reed this suggested contamination by pesticides used in agriculture , the rest of the springs were lower proportions. The increased bicarbonate (HCO^-_3) concentration of the samples after rainfall is due to the dissolved rocks by water leakage between the rock layers, and contains calcium salts in lime dolomitic rocks. There is a high percentage of iron in alkikapa spring reaching the 325mg\liter, which exceeding the permitted limit of 300mg\liter of the WHO standard. It is shown also in the spring of Abo_Issam at 299.4mg\liter and this indicates the presence of contamination of these two springs. The high concentration of sulphates and chlorides in the springs of Abu _issam spring is more the other of the springs due to its proximity to the house in the area and the probability of leakage of contaminated liquid water from home. Most fountains drinking study indicate of no pollutants resulting from solid and liquid wastes and pesticides to these springs. The study showed how important stages of the region a large number of springs sited in a very small geographical unit. The continued existence of the landfill near the springs will be future catastrophic effects to the spring water.

REFERENCES

Abu Hiluo, F., 2008. Spatial and Temporal variation in the hydrochemistry and isotopic composition of the groundwater in the Jordan rift valley. Master Thesis, Birzeit University, Ramallah.

Baroud and Salman, 2002. Wastewater and its impact on the aquifer in the province of Deir al-Balah. Journal of the Islamic University, Gaza, Palestine, volume 10.1, pp. 69-107.

Hussein, Hammoud and Hajjar, 2009. Pollution of groundwater in the basin of Damascus with nitrates (a problem and processing). Damascus University Journal of Engineering Sciences. Volume 25.1, pp. 135-149.

Mahasna and Ali., 1998. Chemical and physical properties of the water fountains and waterfalls Ma'in and distribution of species of green algae - the bluish. Al-Manar Journal, volume 3.3, pp 11-21.

Purdue University, 2012. Heavy Metal Concentrations for Spring Water Samples from the Natuf Catchment. West Lafayette, IN, USA (unpublished data).

Samhan, N., 2007. Groundwater Assessment of The North Westren Auga Tamaseeh Basin (Tulkarm Area), Master Thesis, Birzeit University, Ramallah.

Shalash, I., 2006. Hydrochemistry Of The Natuf Drainge Basin Ramallah/West Bank, Master Thesis, Birzeit University, Ramallah.

Sulieman, S., 2010. Environmental Flow Regime for Wadi Zomar, Master Thesis, Birzeit University.